InLCA: Selected Papers

Incorporating Costs in LCA

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Abstract. The goal of LCA is to identify the environmental impacts resulting from a product, process, or activity. While LCA is useful for evaluating environmental attributes, it stops short of providing information that business managers routinely utilize for decision-making – i.e., dollars. Thus, decisions regarding the processes used for manufacturing products and the materials comprising those products can be enhanced by weaving cost and environmental information into the decision-making process.
Various approaches have been used during the past decade to supplement environmental information with cost information. One of these tools is environmental accounting, the identification, analysis, reporting, and use of environmental information, including environmental cost data. Environmental cost accounting provides information necessary for identifying the true costs of products and processes and for evaluating opportunities to minimize those costs. As demonstrated through two case studies, many companies are incorporating environmental cost information into their accounting systems to prioritize investments in new technologies and products.

Keywords: Environmental accounting; environmental costs; environmental externalities; InLCA; LCA; LCC; Life Cycle Assessment (LCA); life-cycle costing (LCC)

Introduction

The goal of LCA is to uncover the environmental impacts resulting from a product, process, or activity and identify opportunities for reducing those impacts. While LCA is useful for identifying environmental attributes, it stops short of providing information in a metric that business managers understand – i.e., dollars and cents. Decisions affecting process or product modifications can be enhanced by weaving cost and environmental information into the decision-making process.

This does not imply that LCA studies which do not incorporate costs have no value. Indeed, life-cycle inventories and impact assessments have helped businesses identify opportunities for improving their products or processes. In cases where the benefits of the improvement opportunity are clear cut (e.g., eliminating a waste stream that is costly to dispose), a back of the envelope calculation may be sufficient for justifying the improvement. However, because environmental improvement projects often compete for a business' scare capital resources, a more rigorous financial analysis is frequently warranted.

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2 Environmental Accounting

Environmental accounting (EA) is the identification, analysis, reporting, and use of environmental information, including environmental cost data. Information necessary for EA includes both material flows through a facility (materials accounting) as well as costs (cost accounting), including environmental costs. Meaningful cost accounting rests on accurate materials accounting – that is, accounting for the flow of materials and resources through a product, process, or activity. Thus, life cycle inventory (LCI), which is essentially a materials accounting application, is a prerequisite to cost accounting.

Once material flows are quantified (e.g., quantity of solid waste generated by a production process), costs (e.g., waste disposal) can be quantified. **Fig. 1** depicts the various categories of costs relevant to project profitability decision-making. Conventional costs typically appear in a company's accounts and include both annual operating costs such as materials, labor, and utilities as well as initial investment costs in equipment, buildings, etc.

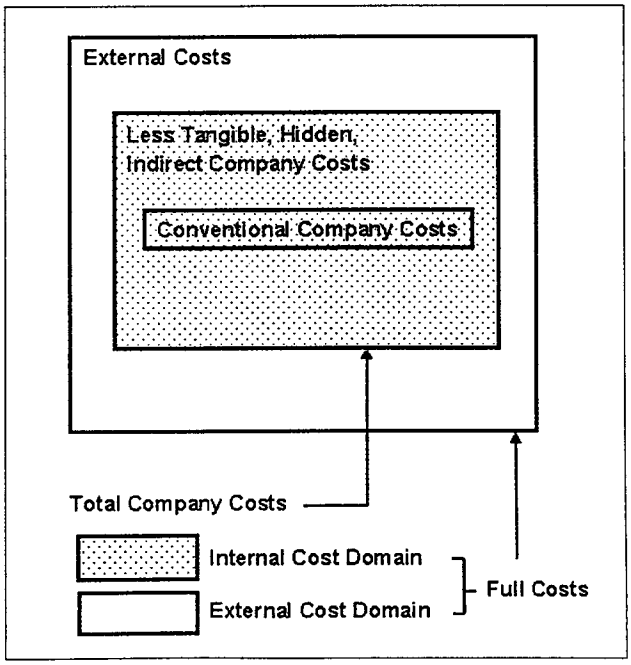

Fig. 1: Cost boundaries

The next outer box is termed less tangible, hidden or indirect costs. These costs are borne by the company, but oftentimes are unintentionally omitted from a financial analysis because they are difficult to measure or quantify, typically are contingent or probabilistic in nature, and are assigned to overhead accounts, rather than the products or processes from which they arise. However, they are no less real or relevant to company finances than conventional costs. Table 1 gives examples of some of these costs.

Table 1: Examples of potentially hidden and less tangible costs

Potentially Hidden Costs	Less Tangible Costs
Up-front: site preparation, permitting, installation	Liability: Superfund, personal injury, property damage
Back-end: site closure, disposal of inventory, post-closure care	Future regulatory compliance costs
Regulatory: training, monitoring, recordkeeping	Employee safety and health compensation
	Organizational image

Together, the conventional company costs and less tangible, hidden or indirect costs provide the sum total of costs for which a company is responsible. When evaluating an environmental improvement project, it is important to fully assess these potential costs and benefits, as demonstrated in the following case study.

3 Printed Wiring Board (PWB) Firm

A PWB firm was considering an investment in a new technology which would impact its production process (Tellus Institute 1998). This process change would reduce chemical use by 17,900 kg/year and reduce water use by 8,058,250 liters/year, and would cost the company $843,000. The company initially estimated a payback period of 2.3 years. However, further analysis revealed a lower payback period of approximately 1.8 years.

What caused this difference in estimated payback period? The company overlooked several costs that would differ between their current business operations and future operations. First, because the new process would involve fewer production steps, labor costs would be reduced. By reducing chemical use and eliminating the use of formaldehyde, regulatory compliance costs would be reduced as well. These costs include a 'generator fee' for using toxic chemicals; US Occupational Safety and Health Administration (OSHA) required monitoring for use of formaldehyde; and staff labor time for compiling information and completing state and federal environmental reporting forms. Lastly, implementing the process change would reduce wastewater treatment costs, not only because the new process would use less water, but also because it would eliminate the use of a chemical that is difficult to treat in the facility's wastewater treatment system.

While a reduction in the payback period from 2.3 to 1.8 years may appear small, because capital investments typically compete for an organization's finite resources, when comparing multiple potential investments, seemingly small differences in costs and savings may ultimately affect which investment is selected. Thus, the experience of this PWB firm demonstrates the importance of considering hidden and less tangible costs.

4 External costs

While environmental accounting provides decision-makers with more complete information regarding the costs for which the firm directly bears, it does not include the outer most box in Fig. 1 – 'social' or 'societal' costs (also, commonly known as environmental externalities). These are the costs of business' impacts on the environment and society for which a company is not responsible at a specified time in that neither the marketplace nor regulations assign such costs to the firm. Examples of these costs are reduced visibility resulting from air pollutants, increased risk of asthma resulting from residual air emission, or global warming resulting from emissions of greenhouse gases.

Why should a firm incorporate external social costs in its accounting? There are at least three reasons (White et al. 1996):

- **Avoiding the 'Regulatory Treadmill'.** Some previously external costs, such as the impacts of discharges to air and water, have increasingly been addressed by regulations that make companies bear more of these costs by requiring pollution controls, reporting of emissions levels, and fines for exceeding regulations. This regulatory trend can be expected to continue, addressing costs that are now still external to companies. To be prepared for future regulatory issues, it behooves industry managers to begin accounting for such external costs now.
- **International Competitiveness.** In today's increasingly global economy, often the highest environmental standards for products become the global standards for companies that wish to compete internationally. Staying ahead of existing standards ensures that a company will not have to retrofit designs and processes in order to stay competitive internationally.
- **Accountability Beyond Responsibility.** Business is under increasing pressure to protect the environment, regardless of what formal regulatory mandates are in place. Stakeholders such as investors, customers, and the general public see the distinction between internal and external costs as an arbitrary one, and expect business to take all environmental costs into consideration.

While external costs are real costs and should be considered, they are often difficult to quantify. Because these costs are borne by society as a whole, and because they often involve goods that are not traded in traditional markets, they do not have a clear market value. Placing a monetary value on goods such as the existence value of open space or endangered species habitat is difficult from both a practical and an ethical standpoint; valuing human health or a human life even more so. Many people believe that such 'goods' have a value well beyond the sphere of money. However, monetization of social costs can be a valuable practice in that it allows for consideration and comparison of both financial and environmental costs within the same format.

The overall approach used to value external costs is the 'damage function approach'. In the case of releases from a manufacturing facility, the damage function approach includes:

- Analyzing **contaminant release and transport.** This step involves determining what contaminants are released from a facility and what happens to those chemicals once they are released. This provides information not just on what is being released but also on when and where it can be expected to have an impact.
- Studying the **effect on resources** of the release. This can include any environmental effects, from natural resources damage to human health effects.
- Determining the **valuation** of the effects.

These steps are in essence a life cycle inventory and impact assessment. However, the last step, valuation, assigns a *monetary* value to the impact, either directly or indirectly. In some cases, external costs occur in the form of damage to market goods. For example, industrial pollution can lead to losses in cattle, fish, or crops. It can also cause health effects, such as asthma, that produce costs to society in the form of medical expenses and lost productivity. The cost of these damages can be estimated *directly* based on lost revenue, cost of remediation, or other costs incurred.

Many social costs, however, do not have a market value in the traditional sense. There are two types of *indirect* valuation methods for monetizing these costs (Bernow et al. 1991, Schulze et al. 1981). One type is *contingent valuation*, a method that involves the use of surveys or interviews to identify the value the public would place on such goods in a fictitious market. For example, people may be polled to determine their willingness to pay to preserve a natural resource. *Revealed behavior* methods, on the other hand, use existing market behavior to estimate the values of public goods. For example, property values may reflect the environmental condition of the property location, such as if it located near a park or a landfill.

The impact of external costs in investment decision-making is described below in a second case study.

5 Selecting Energy Resources

One area where environmental costing techniques have been applied in the United States is the electric utility industry. In the past, energy regulators (i.e., state public service commissions or public utility commissions) in several states have proposed or adopted pollutant-specific monetary values to be used in energy planning. These costs are added to the direct cost of producing energy for purposes of resource evaluation and selection only – these values are not reflected in rates charged to electricity customers. Placing monetary values on environmental impacts and including these costs with the direct economic costs of energy production ensures that these costs are considered in utility resource planning.

Fig. 2 demonstrates the impact that environmental costs may exert on resource planning – in this case, deciding what

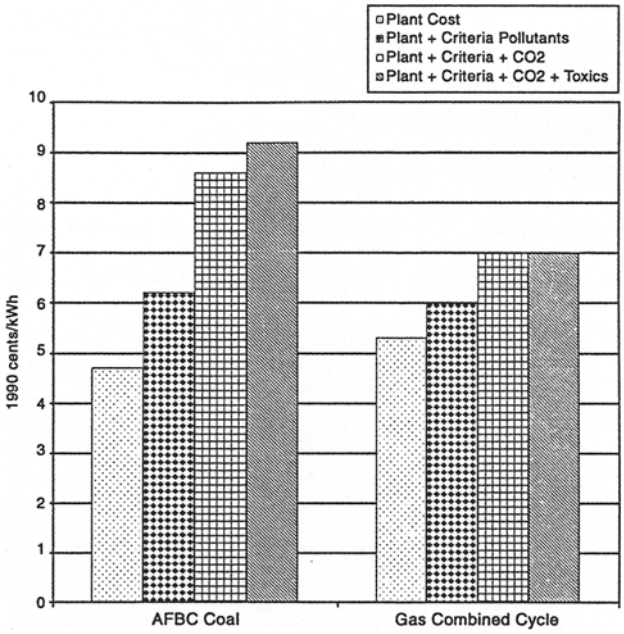

Fig. 2: Costs for new fossil fuel power plants

type of fossil fuel power plant should be built to meet increasing electricity demand. Decisions based solely upon internal costs would favor building an air fluidized bed combustion coal plant over a gas combined cycle plant. However, when the environmental costs are added to the decision calculus, including criteria air pollutants (NO_2, SO_2, CO, PM_{10}, O_3 and lead), CO_2 and air toxics such as mercury, the gas plant is more favorable.

6 Conclusions

Environmental accounting provides a framework for melding the materials accounting information provided by LCA with cost information that is the pillar of business decision-makers. To date, most firms use a pragmatic approach to encompassing costs, focusing chiefly on internal costs. However, proactive firms can align their operations and management strategies with the goals of sustainable development by considering external costs in their decision making.

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